International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-8, Issue-6; Jun, 2021
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.86.35

Development of an Application on Environmental Certification: Describing the experience

Leidy Dayane Paiva de Abreu[1], Nájila Rejanne Alencar Julião Cabral[2]

[1]Postgraduate Program in Environmental Technology and Management, Federal Institute of Education, Science and Technology of Ceará, IFCE, Brazil.
[2] PhD Professor of the Postgraduate Program i.n Technology and Environmental Management at the Federal Institute of Education, Science and Technology of Ceará – IFCE

Received: 11 May 2021;

Received in revised form: 07 Jun 2021;

Accepted: 15 Jun 2021;

Available online: 24 Jun 2021

©2021 The Author(s). Published by AI Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

***Keywords*— Information Technology, Environmental Management, Mobile Application. Green Municipality Seal**

Abstract*—*The study aims to describe the experience in developing a mobile application on environmental certification. An experience report was carried out in the development of a Mobile Application (APP) developed under the Graduate Program in Technology and Environmental Management of the Federal Institute of Education, Science and Technology of Ceará - IFCE, Fortaleza-CE, in the period from January/2020 to April 2021, with emphasis on the environmental certification of the Green Municipality Seal Program (PSMV) of the State of Ceará, more specifically on the environmental indicators of its 13th Edition. The application pilot uses standardized languages to feed the environmental certification information system database, in addition to a pleasant and easy layout. The experience was successful in developing the initial prototype of an application that could contribute to a better assessment of municipal environmental management indicators, and could encourage other cities, states, and even other countries to use digital tools (APP) for data collection, as well as the environmental indicators of environmental certification to improve environmental quality.

I. INTRODUCTION

The increasing degradation of the environment and the depletion of natural resources, caused by indiscriminate production practices, by the current and unlimited human needs and also by the mistaken ideas that natural resources are inexhaustible, make the current and future environmental situation a constant concern of world and national leaders [1].

The conservation of the environment raises questions about the role of public management and society. From the 1980s onwards, in Brazil, with the new concepts of sustainable development approached, the relations between environmental sustainability and economic development were accentuated.

According to Quental et al [2], sustainable development is understood in its three dimensions: economic, social and environmental. It seeks, the well-being of people and their prosperity, with sustained growth in harmony with the protection of the planet, so that it supports the needs of current and future generations, and in peace.

Over the years, public institutions have sought management tools for decision-making in municipalities and local communities to reduce environmental impacts and, consequently, to improve environmental quality in cities and in the countryside. With this, environmental management gains a growing space in local public policies [3].

In order to establish harmonious relationships between the development of socioeconomic activities with the

maintenance of environmental quality, there are environmental management instruments that can help in this process, such as the environmental certification instrument.

Environmental certification corresponds to an advanced stage of environmental management in public and private institutions, in which the environmental variable is inserted in the organizational field. It is a voluntary commitment of the organization to adopt an environmentally correct behavior in relation to environmental management, based on standardized norms and recognized nationally or internationally [4].

With the purpose of facing these problems and qualifying cities regarding the environmental situation in the state of Ceará, the State Secretariat for the Environment - SEMA coordinates the "Green Municipal Seal" Program (PSMV), which constitutes environmental certification [5]. PSMV is a public Environmental Certification Program, established by State Law No. 13,304/03, amended by Law No. 16.128, of 14 October 2016 and regulated by Decrees No. 27.073/03 and No. 27.074/ 03 [6].

The environmental certification of the State of Ceará, through the PSMV, is configured as a management tool that aims to verify the contribution of public policies to the environmental management of municipalities in Ceará, with the goal of promoting environmental protection, supported by the mobilization of community and public bodies, verifying the commitment of the urban environment management [7].

Information technologies have proven to be strong in various aspects of environmental management. The search for solutions requires a globalized view of causes and consequences, for that, technological innovations are adopted. Among them, information systems stand out, which allow collecting, processing, storing, transmitting and displaying information about a given topic. Considering the importance of accessibility to environmental information, national and international public policies establish Environmental Information Systems as instruments [8]. Alongside these innovations, the first portable cell phones were developed. Since then, new features have been added, a fact that has contributed to making the mobile phone one of the technologies most quickly adopted by mankind.

The experience reports the initial stage of the development of an application prototype aimed at public environmental certification in the State of Ceará. The choice for the development of the application started with our performance, in the Municipal Environmental Authority of the Municipality of Sobral-CE, in the work group of the Green Municipal Seal Program. It was through the limitations and potentialities in carrying out the data collection for certification in that municipality that the idea of the need to recognize the importance of environmental management combined with technological tools with the use of mobile devices to contribute to the process of making A conscious decision is the potential qualification of a municipality, which uses the tool, in relation to environmental indicators.

The purpose of the experience is to present how the Management Mobile Application (APP) was developed to assist the environmental certification process of the indicators of the Green Municipal Seal Program (PSMV). The APP is intended to be an accessible tool to communicate, monitor, educate and inspire a target population, offering consistent environmental management through an interactive format.

II. MÉTHOD

This is an experience report of the development of a Mobile Application (APP) under the Graduate Program in Technology and Environmental Management of the Federal Institute of Education, Science and Technology of Ceará – IFCE, Fortaleza-CE. The experience was carried out from January/2020 to April 2021, with an emphasis on the environmental certification of the Green Municipal Seal Program (PSMV), more specifically on the environmental indicators of its 13th Edition.

The Green Municipal Seal Program has been contributing to the effective implementation of environmental public policies at the local level, as well as to the internalization of environmental issues in programs, plans, projects and actions aimed at the cultural, social, economic, political and ecological development of Ceará's municipalities. The 13th edition of the Green Municipal Seal Program has five thematic axes that reflect the ISA are: Municipal Environmental Policy; Environmental Sanitation and Public Health; Water resources; Sustainable Agriculture and Biodiversity and Climate Change [7].

For analysis of the experience, the 13th Edition of the Technical Manual of the Green Municipal Seal Program of the State of Ceará and other literatures that supported the experience and review of Benchmarking were used.

III. RESULTS

The experience presents the first moments for the development of the initial prototype, with two initial phases, which are: First phase: Bibliographic survey and Benchmarking; Second phase: development of the initial prototype.

First phase: Bibliographic survey and *Benchmarking*

We sought to describe this experience through a bibliographic survey in the scientific literature and a review of APP operating systems in virtual stores for benchmarking to later develop the prototype.

The review of virtual stores aimed to identify and analyze functional and operational aspects, which served to support the creation of the APP with ideas, innovative (radical and/or incremental) and effective characteristics; which have parameters not yet available on the market, thus ensuring maximum efficiency in the created product (performance).

To achieve the proposed objective, a survey was carried out on APP available in virtual stores of the main operating systems used in Brazil. Android - Google play store (https://play.google.com/store/apps?hl=pt), iOS - Apple store (http://www.apple.com/br/) and Windows Phone - Microsoft (https ://www.microsoft.com/en-us/windows/view-all). Google play: the APPs were located in the category, the most variable categories such as "Tools", "Lifestyle", "Climate", "Communication", "Educative" and "Social" were used as filter, using the search engine "Management Ambiental", "Environmental Certification" in Portuguese and English. It is noteworthy that there were no tools, in Brazil, such as environment and environmental management, making the search difficult, as well as making the product unprecedented.

APP STORE: the most popular, free Apple APPs, arranged in the "Environment" categories; "Environmental management"; "Companies (APP and business). Installables on iPhone, iPad or any other device with some version of the iOS operating system were catalogued. The inclusion criteria adopted were: available for mobile devices (smartphone or tablet), free APP, running on selected platforms (Android and iOS), with content or tools aimed at environmental management in Portuguese or English. APPs with restrictions for use in Brazil.

To conduct the selection of APPs in virtual stores, the PRISMA checklist was used. The included APPs were downloaded and installed on a smartphone device according to its operating system. Thus, for the Android system, the Smartphone Samsung Galaxy S20 FE 128GB® was used, and for the iOS the iPhone 6 Apple 64GB®. As can be seen in the flowchart (Figure (1).

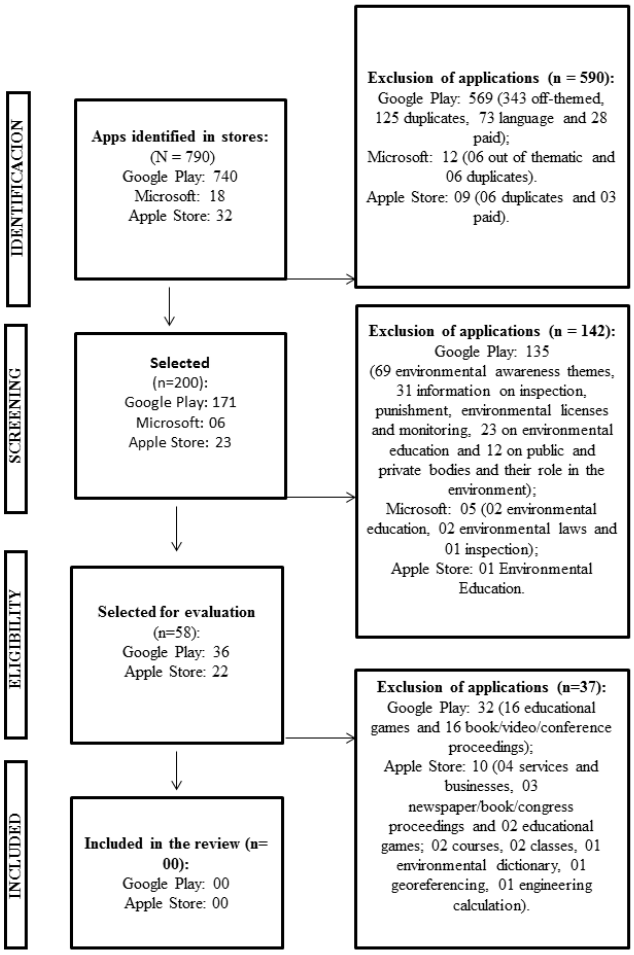

Fig. 1: Flowchart of application selection in online stores selected for review, based on PRISMA – Fortaleza-Ceará-Brasil, 2021.

Source: Authors, 2021.

APPs on environmental certification were not found, which makes the development challenge greater and the final product unprecedented. It was observed in the analysis that there are several software related to environmental issues, but with other functions, different from a certification tool with environmental indicators.

The APPs found were about awareness, environmental education, about the functions and mission of public and private bodies and the role in the environment, as well as information applications on environmental licensing with themes of inspection, punishment, environmental licenses, monitoring and environmental laws, in addition to the most varied educational games, courses, classes, as well as other tools, such as an environmental dictionary, georeferencing APP and/or environmental engineering calculations.

No applications on environmental certification were found, which reinforces the need to develop an application aimed at the Green Municipal Seal Program, as well as its innovative character.

Development phase: initial prototype

The tool aims to guide municipal managers and professionals who make up the Technical Commission and Management Committee of the Green Municipal Seal Program, in order to assist them in the task of analyzing and evaluating environmental indicators, with a view to understanding the relevance of each of the environmental variables and the municipality's competence in achieving the local territorial development agenda. The tool also proposes to show society in a transparent way how the environmental certification process takes place.

For development, the evaluation indicators of each municipality were used. The municipalities are evaluated by meeting sixteen established indicators, being distributed into five thematic axes, totaling 100 points. The Environmental Sustainability Index (ISA) is the sum of all scores on the five axes (see Table 1).

Table 1 – Thematic axes and Indicators for the evaluation of municipalities in the 13th edition of the Green Municipal Seal Program, 2019-2020

THEMATIC AXIS	Maximum Score
AXIS 1 - MUNICIPAL ENVIRONMENT POLICY	32
Indicator 1: Environment Structure	15
Indicator 2: Effectiveness of Municipal Councils for the Defense of the Environment (COMDEMA)	4
Indicator 3: Implementation of the Environmental Education Policy	12
Indicator 4: Deployment of Sustainable Technologies	1
AXIS 2 - ENVIRONMENTAL SANITATION AND PUBLIC HEALTH	36
Indicator 5: Integrated Solid Waste Management	10
Indicator 6: Final disposal of urban solid waste	4
Indicator 7: Social inclusion of recyclable material collectors	6
Indicator 8: Infestation by Aedes aegypt	5
Indicator 9: Sanitary Sewage System and Water Supply System	11
AXIS 3 - WATER RESOURCES	7
Indicator 10: Improved Water Quality	7
AXIS 4 - SUSTAINABLE AGRICULTURE	5
Indicator 11: Sustainable Management of Agricultural production	3
Indicator 12: Capacity Building in Sustainable Agriculture	2
AXIS 5 - BIODIVERSITY	20
Indicator 13: Municipal Conservation Unit (UC)	5
Indicator 14: Urban Green Areas	5
Indicator 15: Preservation and Conservation of Biodiversity	5
Indicator 16: Untying and Burning Control	5
TOTAL CERTIFICATION POINTS	100

Source: Cabral et al (2019).

A technological support tool was initially developed to map the municipalities that serve and that score best in terms of indicators. Through the tool it will be possible to improve performance and facilitate actions for environmental preservation and conservation.

The municipal environmental technicians will be responsible for supplying a mobile platform with information and proof of compliance with the indicators. The tool automatically calculates the ISA (Environmental Sustainability Index) and informs whether or not it has obtained the minimum score (cut score) that will enable the probable granting of the seal (certification), as well as informing the failures (gaps) in getting the seal. Through this tool, managers and the State Secretariat for the Environment of the State of Ceará (SEMA) will be able to identify the municipalities with the greatest difficulties and deficiencies in sustainability, enabling a mapping of actions to be carried out from there. The focus is that all municipalities can be serving and promoting actions so that the situation in their municipality improves every day.

Requirements are the starting point for the entire definition of the system and, consequently, are decisive factors in the development of the final product. Requirements management is always a challenging activity in future software development. This is because the requirements of a system are extremely dynamic, with several factors internal and external to the project, contributing to its constant change.

Through the APP, the population will be able to see how is the performance of their municipality, news and actions that are being carried out within the state of Ceará, aiming at a better performance in the elaboration of environmental policies to serve the population more efficiently.

Mobile environment

Through the mobile APP, citizens will be able to view a map that shows the status of each municipality and whether or not it fulfills its obligations with environmental actions. Figure 2, 3.

Fig.2, 3: Mobile Vision, Fortaleza, Ceará, Brazil, 2021.

Source: Authors, 2021.

The initial screen of the APP Programa Selo Município Verde application aims to be very self-explanatory, through a simple interface.

It also has the space for registering the technician responsible for the municipality's information, in which he registers to send his municipality's data.

All areas of the APP Programa Selo Município Verde, when clicked, will direct to where the municipal technician can send the documents and view the acceptance of a certain environmental variable, for later scoring.

The indicators of the chosen area that are touched will direct to the page where it will be possible to send the proof files.

According to the compliance with the 16 indicators and after the documental evaluation of the Technical Commission, the municipalities are sorted, according to the score achieved, being necessary a minimum of 50 points in the Environmental Sustainability Index (ISA) to be classified in 3 different categories (A, B and C) and subsequent certification (Table 3). After the documentary evaluation, the score achieved by the municipalities with the overall classification is released. Each municipality that achieves the necessary score for classification will receive an on-site visit by technicians to verify the information identified on its form (see Box 2).

Table 2 – Environmental Sustainability Index and Categories according to the classification of municipalities for certification in the Green Municipality Seal Program

ISA Range	Category
$\geq 90 \leq 100$	A
$\geq 70 \leq 90$	B
$\geq 50 \leq 70$	C

Source: Cabral et al (2019).

The application presents the average score for the municipality (see Figure 4):

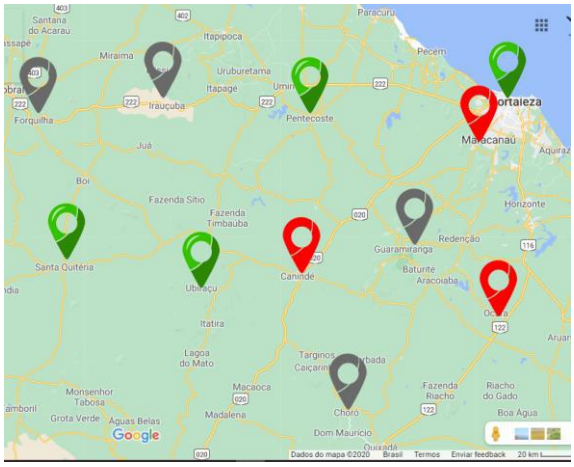

Fig.4: Average score by municipality, Fortaleza, Ceará, Brazil, 2021

Source: Authors, 2021.

The results are intuitive. Municipalities that are still in the process of analysis, as shown in Figure 4, are in the color "gray", municipalities that obey and comply with the proposed indicators will appear in "green" and those that are not following and complying with the indicators will appear in red. The cities that do not adhere to the certification process in that edition will also be in red, considering that their adhesion is voluntary. This is a simplified view for the population, but it allows important information on the current situation of commitment of municipalities in Ceará with sustainability. For SEMA, the state environmental management agency, coordinator of the PSMV, the detailing of information will be much more precise. With the help of graphics and real-time information, it will be simple to always obtain the best metrics for strategic decision-making based on statistics and results.

With an application with a cloud database, it is possible to control which municipalities have proven compliance with each of the indicators. SEMA is able to see through graphics and a geographic map each municipality that is "regular" and those that did not follow what was pre-established in each indicator and, through this, elaborates more assertive environmental policies and actions for each municipality.

On the other hand, the population acts in a participatory way, as it manages to monitor the municipalities in real time and the indicators that they are regular.

The municipal managers will always act seeking to meet what is requested so that they migrate from the "irregular" to "regular" scenario. (see Figure 5):

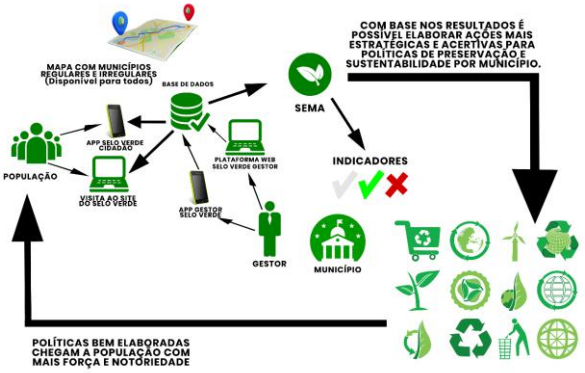

Fig.5: Ways of viewing and storing information, Fortaleza, Ceará, Brazil, 2021

Source: Authors, 2021.

The result of all this is a B.I (Business Intelligence), that is, a set of data referring to the situation of

preservation and sustainability of each municipality and its commitment to improving results. This information can be used for immediate decision-making or preparation of future actions and projects always seeking a better framework of preservation and sustainability for each municipality in Ceará.

IV. DISCUSSION

Currently, there are several researches on application studies and development, with bibliographic research in the scientific literature and a non-e-store review of APP operating systems for benchmarking for planning the development of technologies such as applications. This type of research allows us to identify, map, respond and discuss significant contributions to the construction of knowledge from different fields of human knowledge. Thus, it constitutes a survey of what is usual about a given area, development of research analysis prototypes, assessment of the situation of knowledge production in the focused area [9].

Given the constantly growing market, the spread of this and other mobile devices, such as smartphones and tablets, around the world is undeniable. Following the same upward projection, the creation of applications (APP) for mobile devices presents itself as an innovative field considering the potential of human interaction with the environment. The increasing number of applications available in online stores represents a data source that is still little explored [10].

Accessibility levels of mobile devices have been increasing in proportion to the growing demand from managers and users of Information and Communication Technologies. This phenomenon can be explained, among other factors, by the incorporation of new data transfer and storage technologies, as well as better information management and strategic management administration [11].

The use of technological tools such as the use of applications in the area of environmental management is in growing expansion, as this type of support can provide professionals with more precision and agility in their work. Mobile computing can be applied in several aspects within environmental management. Among these applications, remote monitoring, local diagnostic support and decision-making support can be highlighted [10].

Sustainability appears as a theme message not only in the so-called “traditional” media, such as press, television and radio; but also in corporate communication, at events, conferences, in the school environment and also on the internet. Some organizations and projects have promoted sustainability in different communication ways, some of them are even application developers [11].

The experience sought to present the initial phase of the development of a prototype on environmental certification through the Municipality Green Seal Program (PSMV) of the State of Ceará. The PSMV emerges not only as an incentive to municipalities to implement their environmental policies, but also as a channel for the effective participation of civil society, in defining their needs and establishing their priorities, considering its great merit, in addition to inserting the environment within the discussions, concerns and commitments of all instances of society, through mobilization meetings and environmental education projects [7].

Over the years, technological advances have become a key element in minimizing the negative effects of human activities on the environment. And in this experience, the relevance of using mobile applications in the environmental management process was discussed. This is because there are a number of software, application and tool innovations that have made the lives of professionals working in the environmental area easier, besides, of course, solving environmental problems [11].

In this way, the experience is justified because in addition to recognizing the importance of environmental management combined with technological tools with the use of mobile devices in order to contribute to the conscious decision-making process, there is the potential qualification of a municipality that uses the tool , in relation to the environmental indicators.

V. CONCLUSION

The development of the initial prototype, in addition to presenting a standardized language, and a pleasant and easily accessible layout, brought a new look at environmental management, through the construction of a digital communication and information tool, which in addition to feeding the system databases of information from the State of Ceará on environmental certification, it is also essential for management, considering the realities, needs and potential of each municipality in Ceará.

Therefore, it can be concluded that the experience was successful in developing the initial prototype of an innovative, pioneering and unprecedented application, which could contribute to better municipal management of environmental indicators, through data collection, analysis, notification and recording. decision-making, encouraging the improvement of indicators in Ceará's cities, with greater sustainability, and may encourage other cities,

states and even other countries to use digital tools (APP) for certification to improve environmental quality.

It is noteworthy that the initial phase of the prototype is an extremely useful and important instrument for requirements validation. This prototype serves to demonstrate the system, how will be the navigation between the interfaces, the forecast reports and so on, reproducing the behavior of the future system to be implemented.

ACKNOWLEDGEMENTS

We are grateful for the partnership with IFCE's Laboratory of Renewable Energies and Environmental Comfort (LERCA), Campus Fortaleza.

REFERENCES

[1] Vedovato, LR; Franzolin, CJ; Roque, LR (2020). Deslocados ambientais: uma análise com base na dignidade da pessoa humana. Rev. Direito e Práx. vol. 11, n. 03, p. 1654-1680. Disponível em: https://www.scielo.br/j/rdp/a/rX3wQWtWThGZ7mSQrP7qzrk/?lang=pt

[2] Quental *et al* (2019). A saúde na Agenda 2030 de Desenvolvimento Sustentável na América Latina: quem está publicando?. Rev Eletron Comun Inf Inov Saúde, 13(4): 922-34.

[3] Pott, CM; Estrela, CC (2017). Histórico ambiental: desastres ambientais e o despertar de um novo pensamento. Estud. av., São Paulo, 31(89), jan./abr. 2017.

[4] Bastos, CS; Calmon, JL; Gonçalves, RF (2019). Gestão das águas na perspectiva da certificação ambiental: uma nova proposta de critérios e taxas de peso para aplicação nas regiões brasileiras. Eng. Sanit. Ambiente, Rio de Janeiro, 24(4).

[5] Cabral, NRAJ (2008). Certificação Ambiental De Municípios - A Experiência Do Estado Do Ceará na Construção De Um Modelo de Desenvolvimento Sustentável. In: Workshop internacional de pesquisa em indicadores de sustentabilidade, 2., 2008, São Carlos, Anais... São Carlos – SP, WIPIS.

[6] Cabral, NRAJ (2011). Análise do Programa Selo Município Verde como instrumento de política ambiental: o caso dos municípios de Caucaia e Tauá/CE. Fortaleza: CNPq.

[7] Cabral, NRAJ; Lima, PVPS; Azevedo, MSF (2019). Manual Técnico Programa Selo Município Verde. Fortaleza: Secretaria do Meio Ambiente. 13ª Edição. Disponível em: https://www.sema.ce.gov.br/wp-content/uploads/sites/36/2019/07/Manual_Tecnico_Formul%C3%A1rio_Avalia%C3%A7%C3%A3o_PSMV_13%C2%AA_Edi%C3%A7%C3%A3o.pdf

[8] Bartlett, A et al (2012). A smartphone app to extend use of a cloud-based irrigation scheduling tool. Computers and Electronics in Agriculture, Amsterdam, v. 111, p. 127-130.

[9] Rothstein, JD. et al (2016). Qualitative assessment of the feasibility, usability, and acceptability of a mobile client data app for community-based maternal, neonatal, and child care in rural Ghana. Int J Telemed Appl., v. 2016, p. 1-14.

[10] Souza, MIF. et al (2018). Microvídeos e aplicativo móvel: estratégia comunicacional de apoio à implementação de legislação ambiental e florestal. Texto Livre: Linguagem e Tecnologia. Belo Horizonte, vol. 11, n. 3, p. 192-212.

[11] Lizzoni L; Feiden A; Feiden A (2018). PLAFIR: aplicativo web para planejamento financeiro rural. Biblios, n. 73, p.01-14. Disponível em: http://biblios.pitt.edu.